

The Madras Agricultural Journal

Vol. XXXVIII

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No. 1

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The Madras Agricultural Journal

Vol. XXXVIII

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Editorial

Editorials, like prefaces are always written, but are seldom read by the average reader, who is usually content to dip into those items that happen to catch his eye first. In our attempts to make the Madras Agricultural Journal more readable and thereby reach a wider public, it is necessary to explore how far an editorial could help, by making it lighter and more attractive. In editorials, too, just as in everything else, there is a wide variety to choose from ; there is the pompous type, dishing out platitudes from the Olympian inaccessibility of the editorial "We" and there is the topical type, where an attempt is made to discuss some topics of current interest. There is also the severely impersonal, scientific type of editorial exemplified in periodicals like the *Nature* and *Endeavour*, which are models of brevity and good English, but they are as a rule a bit too tough for the casual reader. At the other extreme is the chatty, discursive type of editorial, found for example in "Better Crops with Plant Food" and the editorial that the gifted writer, Stephen Miall, used to write every week in the "Chemistry and Industry". These were delightful little essays, reminiscent of Charles Lamb and E. V. Lucas and served as a very good foil to the technical nature of the other articles contained in that journal. The snag about this type of editorial is that it is not every housewife that is capable of preparing light pastry.

Yet another kind is what may be termed the menu card type of editorial, found in the Fiji Agricultural Journal and the Indian Coconut Journal, which serve to introduce the articles contained in that particular issue. And the last and perhaps the most successful solution is the one that omits an editorial altogether, but plunges straight, as in the American Journal of Botany, and the Indian Journal of Horticulture, into presenting the articles by different authors on different subjects.

In keeping with our usual practice of discussing topical items, the recent visit to Coimbatore of the distinguished British scientist Sir John Russell, may be mentioned in this issue. This world-famous agricultural expert and author of the classical "Soil Conditions and Plant Growth" had visited India once before in 1936-1937 and submitted a very useful report to the Government of India, reviewing the work done so far in Agricultural Research

and suggesting lines of further improvement. The present visit is his second one, to India. Seventy-eight year-old Sir John Russell, who was accompanied by Lady Russell as well, visited Nagpur, Bangalore, Coonoor and was at Coimbatore on the eighth of January. He professed to be very favourably impressed by the work that is going on in these various places. "The work that is going on" he said, "in the agricultural experiment stations and model farms in Mysore, Coimbatore and other places in South India offers the prospect of solving to a great extent, India's food difficulties. The practical difficulty is to get better materials over to the peasant, to enable him to adopt the methods suggested by agricultural experts. In the control of soil erosion too, we have the necessary scientific knowledge, but there remains always the practical difficulty of getting these methods adopted and properly carried out."

Undoubtedly, such periodical visits by distinguished scientists from other countries do help a great deal in widening our outlook and perspective, but it is also well to remember that in the final count, each one of us has to solve our problems ourselves and cannot depend, like the farmer and the skylark in Aesop's Fables, on other people to do our work for us.



BRITISH SOIL SCIENTIST IN INDIA

Sir John Russell, eminent British soil scientist, who is at present touring India, will discuss local agricultural problems with the authorities. With degrees from the universities of many countries, and membership of numerous foreign academies, Sir John Russell ranks as one of the world's foremost soil scientists. A Fellow of the Royal Society, he was the first agricultural scientist to become president of the British Association (1949). He has published many books dealing with soil conditions.

Studies on Dormancy in Rice — A Preliminary Note

By

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and

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(Received on 19—12—1950)

It is well known that most of the short duration varieties of rice do not require a resting period after harvest as a pre-requisite for proper germination. This is advantageous inasmuch as the seeds harvested in one season come in handy for immediate sowing in the succeeding season. But the disadvantages are more than one. If for any reason the harvest of the ripe crop is delayed, it lodges on account of age or due to wind or beating rain and the grains germinate in contact with water which always stagnates in the field at the harvest time of such early varieties in many parts of the rice-growing tracts. Even if the crop does not lodge and come into contact with the water film beneath, some moisture left in the ear helps to germinate the grains in some of the short duration types. Adt. 19, a strain isolated in the variety Sarapalli, is one which succumbs easily to this condition. It has also been recorded that varieties which have a quick-after-harvest sprouting have also a tendency to lose viability under normal conditions of storage. This is found in some of the medium duration varieties also. Co.3 Vellaisamba is a case in point. It deteriorates as quickly as some of the short term rices, especially when the seeds in storage have to pass through a heavy monsoon period as in the districts of Malabar and South Kanara.

Since short duration varieties, are time-limited, they are less susceptible to the vagaries of seasons, and induction of dormancy in such types of hybridization would prove a useful line of work in rice improvement. By way of preliminary investigation, 140 short duration types mostly Chinese and Japanese, with durations ranging from 80 to 120 days, were selected for study. Ripe earheads from each were collected and immersed in about half an inch of water kept in a shallow tray and the number of grains germinating was counted every day for seven days. Percentage values of germination are presented in Table I.

TABLE I
Germination percentage of the types

Germination percentage }	0-10	11-20	11-30	31-40	41-50	51-60
Number of types }	22	6	1	1	...	3
Germination percentage }	61-70	71-80	81-90	91-95	96-100	-
Number of types }	...	3	4	4	150	

Out of the 140 types, 109 gave 91 to 100 per cent germination, 18 types from 10 to 90 per cent while 22 gave nil or up to five per cent germination. The nature and extent of germination in the above varieties, as grouped into four duration groups 50 to 60, 61 to 70, 71 to 80 and 81 to 90 days are brought out in plates I, II, III and IV.

As a result of the study it has been possible to fix up types which are not only very good yielders but are also completely dormant. Interesting variations in after-harvest sprouting of short term varieties could also be observed. The following tentative conclusions were drawn:—

Those that gave 100 per cent germination are those that possess short and broad grains with an L/B ratio of less than three and the husks are coarse, thick and hairy with stiff silica hairs, providing a larger pervious layer for absorption of moisture for quick germination.

It is proposed to follow up this line of work in all the seasons and study the seasonal variations regarding absence of dormancy and its association with size of grain, texture of kernel, thickness of husk and allied characters.

The Madras Agricultural Journal

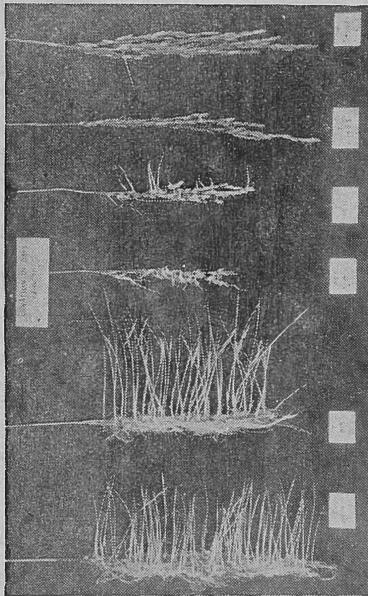


Plate I

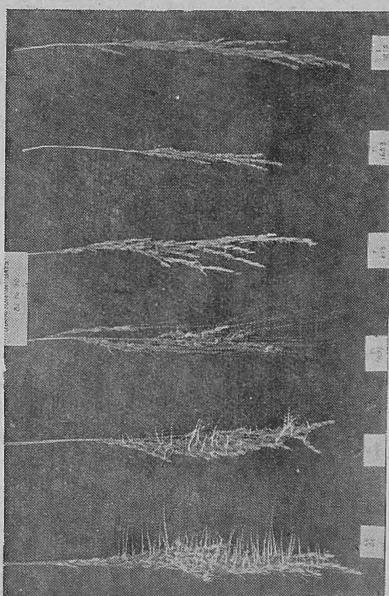


Plate II

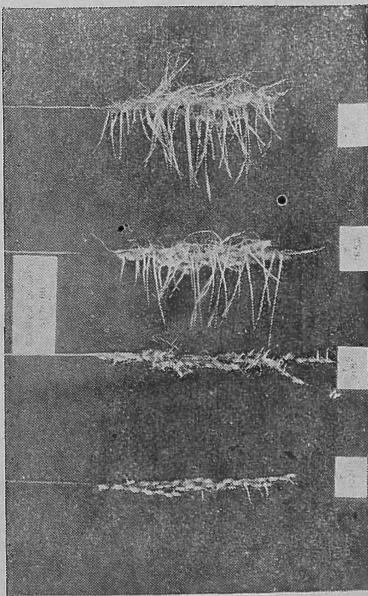


Plate III

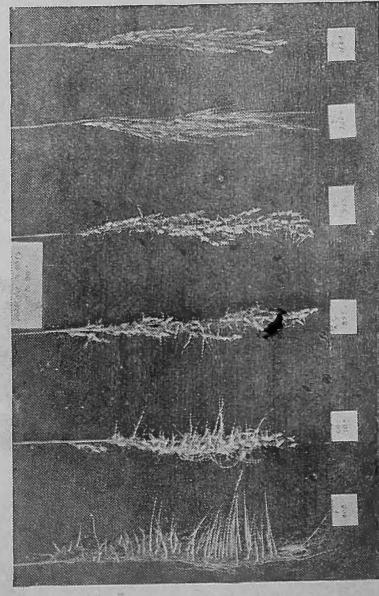


Plate IV

Tapioca

By

SRI V. T. SUBBIAH MUDALIAR,
Lecturer in Agriculture, Coimbatore.

(Received on 19-12-1950)

Tapioca is grown in large areas in Malabar and Travancore along the West Coast, taking advantage of the heavy rains from June to December. It is serving as a subsidiary food crop for the poorer classes of people, particularly in lean years. It is also an efficient substitute for rice to some extent, supplying the necessary carbohydrates. The accompanying statement furnishes the food values of rice and tapioca, based on the average yields obtained in the Madras State and the food values given in published literature.

	Rice	Tapioca
1. Duration in months	5	7-10
2. Acreage in Madras State	10,774,620	42,600
3. Yield in pounds per acre	1,127	9,432
	(clean rice)	(tubers)
4. Protein in pounds per acre	78	68
5. Carbohydrates in lb. per acre	892	3,651
6. Calories per acre (in thousands)	1,776	6,794

Tapioca produces nearly four times as many calories as rice, from the same area. Such comparisons have however their limitations, as there are wide variations in the requirements in soil, climate and water of different crops and fundamental differences in the duration of the crops. Any comparison made has therefore to be treated only as indications.

The following analysis gives the food and vitamin values of tapioca tubers, both raw and dried, and rice as percentages:—

	Tapioca tubers		Rice
	Raw	Dried	
Moisture	59.4	13.0	13.0
Protein	0.7	1.5	6.9
Fat	0.2	0.4	0.4
Mineral matter	1.0	2.1	0.5
Carbohydrates	38.7	82.9	79.2
Calcium	0.05	0.11	0.01
Phosphorus	0.04	0.09	0.15
Iron	0.9	1.9	1.0
Vitamin value per 100 grams			
Vitamin A	...	...	...
Vitamin B	15	32	20
Vitamin C	...	...	...
Calorific value per 100 grammes	159	341	348

The air-dry tuber material is as rich as rice in carbohydrates and the value of the other nutrients is not much less. The tubers are mainly a carbohydrate food, capable of making up the deficiency of rice as a subsidiary food.

There is at present a shortage of food produced in the country, which is made up by imports of grains from other countries at great cost. This is not desirable, nor can it be a lasting and permanent solution. The production has to be linked up with the requirements and consumption in the country. Imports of food grains should be stopped and India should produce its own food. Everything that will help in reaching the target has its place in our development programmes. The production of subsidiary food crops like tapioca to replace cereals in part is one of the main lines of attack suggested. Tapioca produces about one and two-thirds of a ton of carbohydrates per acre, while rice produces only two-fifths of a ton. The production of carbohydrates through tuber crops like tapioca should assist materially in tiding over the food shortage. This then would appear to be the proper thing to do and it has been shown to be feasible in Travancore and Malabar by the poorer classes of people. It is imperative that the people should learn to adjust their food habits to the prevailing conditions, so that there may be less of privation and suffering on the whole.

The Tapioca Plant: The tapioca plant is also known as the 'cassava' in other countries. Its botanical name is '*Manihot utilissima*'. It belongs to the family of Euphorbiaceae and other known members of the family are the castor plant and the rubber tree. Tapioca is an erect shrub, not much branched, that grows to a height of 6—9 feet. Some of the roots get thickened in due course by storage of starch. The plant is capable of being propagated both vegetatively, as well as sexually. It is usually propagated vegetatively only. It is treated as an annual crop, though it has perennial habits. The tubers have small amounts of cyanogenetic glucoside, which hydrolyses and sets free hydrocyanic (prussic) acid, a virulent poison. The glucoside present in cultivated forms is generally negligible. There are allied wild types having a bitter taste and larger quantities of glucoside. The glucoside is destroyed by cooking and the tubers are thereby rendered safe for consumption. The duration of the crop ranges from 7 to 12 months. There are minor differences in the leaf, stem and tuber characters of the varieties under cultivation.

Climate, Water and Soil Requirements: The crop is grown in tropical and sub-tropical regions and at elevations upto 2,500 feet, but the crop is at its best only at lower altitudes. It is said that it is grown in America at elevations upto 7,000 feet above sea-level. Tapioca stands drought well, but not stagnation of water. Tapioca planted in Malabar in

December with the last rains, establishes itself and makes a little growth before summer. The young plants are able to withstand the summer conditions and recommence growth in May, on receipt of rains. The crop thrives in open sunny situations and does not grow properly in the shade.

The crop is grown under a wide range of rainfall. It is grown in regions receiving less than 20 inches of rainfall in America under sub-tropical conditions. It flourishes in tropical Malabar with a rainfall of about 125 inches during the growing period, and thrives in Visakhapatnam district, where the rainfall is about 30 inches during the crop season. It does well under irrigation but does not tolerate saline water.

It is grown also in a variety of soils. The sandy soils of the East Coast, the laterite soils of the West Coast and the red loams of the central districts grow good crops of tapioca. Even the hill slopes and waste lands considered unsuitable for other crops grow good crops of tapioca in Malabar and Travancore, while in the richer red loams by their side, the crop is more exacting in its water requirements.

Clayey and sticky soils do not permit the full development of the tubers. There is difficulty in digging the tubers and the cost of cultivation is unduly increased. Saline soils are not tolerated by the crop.

Tapioca is an exhausting crop and responds well to liberal manuring combined with heavy irrigation. Because of this, the crop that follows tapioca is generally poor, unless it is manured adequately.

Season: The general planting season is June-July, with the break of the South-West monsoon, whether the crop is grown under irrigated or rain-fed conditions. June-July planting gives the benefit of both the South-West and North-East monsoons and makes it possible to cultivate this long duration crop successfully. Where the South-West monsoon is not effective, the planting is done in September and October, with the commencement of the North-East monsoon, as in the southern districts and as a second crop in the Nilgiris. Where pre-monsoon showers are received as in Nilgiris and Tanjore, the crop is planted even in April and May. It is also planted in December and January in the garden lands of Visakhapatnam, Chingleput and South Arcot districts, where there are facilities for irrigation.

In North India, tapioca is planted in March, after the cold weather. In Uttar Pradesh (U. P.) the crop is planted in February to April, with the April planting giving the best results. It is planted right through the year in Travancore, excepting during the dry months, December to March. Thus the crop is not season-bound.

Varieties: A large number of varieties are grown all over the world. There are varieties that mature in 6 months and there are others that take 10—21 months to develop the tubers. There are differences between the varieties in morphological characters such as the height of the plants, shape of the leaves, colour of the stems, leaves, petioles and tubers, and so forth. The colour of the rind of the tubers range from white to chocolate brown, through shades of yellow and white. The colour of the flesh of the tubers is either white or cream. The tubers are spindle-shaped and vary in thickness and length. The cyanogenetic glucoside of the tuber also varies. The cultivated varieties have only a trace of the glucocide and are sweet. The wild forms have a higher glucoside content and the raw tubers are bitter to the taste.

Preparatory Cultivation: The land is prepared by ploughing with the common wooden plough 3 to 5 times to bring about a good tilth. Manure is applied before the last ploughing. The land is finally ridged up, with the ridges 3 to 4 feet apart, or laid into beds 3 to 4 yards square in irrigated lands. In dry lands, the land is either ridged up or pits are dug 3-4 feet apart either way for planting. The pits are usually 1 ft. \times 1 ft. \times 1 ft. The land is dug up in the Nilgiris and the hill slopes of Malabar. Later ridges are made 3-4 feet apart, with contour drains every 15—20 feet to take off the surplus water during heavy rains.

Manuring: Cattle manure is commonly applied at 10-20 cart loads (=5-10 tons) per acre, before the last ploughing almost throughout the state. Sheep-penning is also done in Visakhapatnam district, at 1,000 sheep per acre. In Malabar, where cattle manure is in short supply, 4-5 cartloads of cattle manure, 2-3 cartloads of green leaves and 10 gunny bags of wood ash per acre are applied. In Godavari, ammonium sulphate is used for top dressing the crop at 100 lb. per acre, two months after planting, in addition to the cattle manure applied during the time of preparation of the land. In Travancore, the pits dug for planting are filled with dry leaves and burnt to ward off white-ant attack. It is said that the application of wood ash helps in the formation of good-sized tubers. West Coast soils are deficient in potash and ash supplies potash so necessary for the elaboration of starch in the green leaves and its translocation to the tubers.

Planting: Tapioca is propagated by planting stem cuttings called 'setts'. The stems of the previous crop are cut, bundled and stored in shade, for use later as planting material. The stems could be kept over for 2—3 months. The stems are cut into bits at the time of planting. The top portion upto a third of the total length that is

tender and not suitable for planting is rejected. A small length at the basal end that is dry is also rejected. The setts are 6-9 inches in length and each stem gives 6-8 setts. Cuttings upto 18-24 inches are used in other countries. Trial indicate that cuttings from the basal end give rise to the largest yield and, cuttings from the apical end the lowest yield.

The setts are usually planted in a slanting position, burying inside the soil 4-5 inches of the cuttings leaving 3-4 nodes above the ground. Setts are planted vertically in certain countries and horizontally in places like Malaya. The number of cuttings required for planting depends upon the spacing given. With 3 feet of spacing either way, 5,690 setts plant an acre and with $2\frac{1}{2}$ feet spacing both ways, 7,200 cuttings are required. Of the setts planted, 70-90 per cent strike root and spare sets are reserved for filling up gaps later.

Irrigation: The crop is grown as a dry crop, mostly in Malabar, Nilgiris, South Kanara and Visakhapatnam districts. Planting is done, with the commencement of the rains and pot watering is done, if necessary, till the sets establish themselves. In other places, tapioca is an irrigated crop. An irrigation is given on the day of planting, followed by two light irrigations at intervals of 3-5 days and the setts establish in 7-10 days. No other irrigation is normally necessary till the close of the monsoon season. Thereafter irrigations are given at intervals of 10-15 days and 15-20 irrigations are required in all, depending upon the soil and the rainfall. The lighter types of soils require a greater number of irrigations than the heavier types.

After-Cultivation: Hoeing, removing weeds and earthing up the plants are the after-cultivation operations done to the crop. The number of times the several operations are done vary from place to place, depending upon the rainfall and weediness of the crop. Hoeing and weeding are done 4-6 times at intervals of about a month and earthing up twice normally, once when the crop is 4 months old and second two months afterwards. The plants are topped sometimes and their growth is limited to 6 feet for facilitating the development of tubers, but this is not a general practice.

Pests and Diseases: Tapioca is a crop that is fortunately free of pests and diseases in this country.

Harvesting: The crop is harvested after the tubers are fully developed. The maturity of the crop is indicated by the yellowing, drying-up and shedding of the leaves. The soil at the base of the plant develops cracks at this period, due to the enlargement of the tubers underground. A few plants are dug and the tubers are examined for their development and maturity. The soil does not stick to the

mature tubers and the tubers do not snap easily after maturity. Flowering and fruiting of the plant are sometimes seen, but these do not indicate maturity of the crop.

An irrigation is given before harvest to moisten the soil and facilitate the harvest. The plants are pulled out with the tubers in light soils. In loamy soils, it is necessary to dig out the tubers with crow-bars and *mammoties*. The stems are cut, bundled and stored in shade covered with leaves for use as setts later. The stems keep in good condition for planting upto 2—3 months, depending upon the weather conditions.

Yields: The yield varies with the soil, its fertility, rainfall and intensity of cultivation. An average of 12 thousand pounds of tubers are obtained from an acre in garden lands, 5—6 thousand pounds from the East Coast drylands and 8 to 10 thousand pounds from the West Coast drylands. High yields of 15—20,000 lb. are often obtained from fertile garden lands and 15—18,000 lb. from the drylands of Malabar. Large yields upto 33,000 lb. are said to be obtained in Malaya. The average yield in U. S. A. is 11 to 13 thousand pounds, though yields upto 35,000 lb. are sometimes secured under intensive cultivation. The longer the duration of the crop, the higher is the yield of tubers, as a rule.

The tubers do not stand storage. They are fit for cooking for a week, from the time of digging, until the tubers get darkened and bluish about the central core, due to the concentration of the cyanogenetic glucoside. In view of their short storage life, the tubers are lifted from the soil only as and when required. The crop can, be kept on the land for about 3 months after maturity, but the tubers get fibrous, coarse and unfit for cooking, in course of time. The tubers are 2—3 inches in diameter and 9—18 inches in length, weighing 2—5 lb. each. If the crop is left on the land for two seasons, coarse giant roots are developed, weighing upto 24 lb. in extreme cases.

Tapioca leaves are often used for feeding goats. Of the stems, 10 per cent is reserved for planting and the rest is dried and used as fuel.

Marketing: The fresh tubers are sold in shandies and market places for use as vegetables. The tubers are boiled with salt and sold in bazars and thoroughfares and are purchased by the poorer classes of people and labourers to serve as a light repast and occasionally as a meal. It is not a complete food by itself and needs the inclusion of legumes to make it more balanced. In Malabar and Travancore, tapioca and fish are a stand-by for the poorer classes, in years of scarcity and famine.

Tapioca Preparations: Tapioca tubers contain variable quantities of a cyanogenetic glucoside, which produces prussic acid on hydrolysis. The tapiocas under cultivation have only traces of the glucoside, but still it is not considered desirable to use raw tubers for consumption. The tubers have to be processed for destroying the glucoside, and it is advisable to supplement tapioca with small quantities of proteinaceous foods like fish, eggs, milk, meat, pulses etc. The following methods of preparing the tubers effectively destroy the glucoside present.

(1) The tubers are peeled, sliced and boiled with an excess of water in open vessels till cooked. The water is drained and the cooked tubers, are made into curries of different types or consumed as such.

(2) Tubers are peeled, sliced and thoroughly dried in the hot sun. The dried chips are free of glucoside and could be kept in storage or made into flour and stored. The flour is used for making cakes, biscuits, *puttu*, etc. Roasted pulse flour is sometimes added to improve the flavour, taste and nutritive properties. The chips can be ground and made into porridge, which is easily digested.

(3) Thin slices of tubers are fried in oil, seasoned with salt and pepper or chilli powder and eaten as snacks.

Manufactured Products: Starch, sago, semolina and flour are made out of tapioca tubers on a commercial scale in Salem and Coimbatore districts.

Tapioca starch: The rind or skin of the tuber is peeled with stainless steel knives or pieces of bones shaped and sharpened in a suitable manner, as the resulting starch is stained if iron knives are used for peeling. The peeled tubers are rasped by power-driven machinery and reduced to a pulpy mass. The pulp is transferred to cement tubs containing water and stirred well, and the turbid liquid is passed on to another tank, where the suspended starch is allowed to settle down and the supernatant liquid is drained. The starch paste obtained is called 'crude starch' which is again agitated with a fresh charge of water and resettled in a third tank for obtaining purified starch. The supernatant liquid is drawn off and the starch is transferred to a muslin cloth to facilitate water being drained. Centrifugal machines are also used for separating water. The starch is finally spread out for drying. The dry starch is then packed for sale. A weak solution of caustic soda is added to all the vats used in the manufacture of starch, to keep the liquid slightly alkaline, in order to prevent fermentative changes taking place.

Starch can be made in a similar way in the ordinary household also. Peel the skin, grate the tubers into pulp and place it in a muslin bag. Knead the pulp in a vessel of water, when starch passes through the bag into water like streaks of milk and the fibrous matter is left behind in the

bag. The kneading may have to be continued in 2 or 3 changes of water to extract the entire starch in the pulp, till the water escaping from the bag is clear and free of starch. The starch is allowed to settle down and the supernatant liquid is drained. The wet starch is spread over a clean cloth and drained in the sun.

(2) *Sago* : The wet starchy paste is dried and rubbed over wire sieves of suitable size even when there is a little moisture, to produce granules of the same size. The granules are then rocked to and fro on pieces of cloth held stretched by coolies. The granules get rounded and form small rounded pellets. The pellets are lightly toasted and graded. The small pellets are sold as 'Sago' and the big pellets are sold as 'Pearl tapioca' or 'Pearl sago'.

(3) *Flour* : The tapioca tubers are peeled, sliced and dried in the sun. The dry chips are made into flour by passing through a disintegrator and mill. The flour is made up of the starch and the crude fibre present in the original tubers and is therefore coarser to the feel than tapioca starch.

(4) *Semolina* : Tapioca tubers are sliced, boiled and dried. The dry slices are ground coarse in flour mills, and graded by suitable-sized sieves for separation into various fractions. The coarse fractions have the appearance of semolina made of wheat and the hotels are nowadays using this tapioca semolina for preparing *Uppuma*.

The output of starch and sago varies from 12—18 per cent of the weight of the fresh tubers, depending upon the maturity of the tubers and the efficiency of manufacture. The flour output is 25 per cent of the weight of the tubers.

The flour is used in the household for making porridge, and cakes of various types fried in oil. It is used by the trade for adulterating the costlier wheat and other flours sold to bakeries and coffee hotels for the manufacture of biscuits, cakes, sweets and savouries.

Attempts are being made to convert the tapioca flour into materials which will cook like cereal grains like rice without becoming a pasty mass. It is said that a mixture of 70% of tapioca flour, 20% of groundnut cake flour and 10% of wheat flour lends itself for being made into a vermicelli-like substance and which could be added to rice upto 20% easily, while cooking. Suitable methods of processing tapioca, either by itself or with other materials, into forms that will appeal to the tastes of the people require to be evolved. The stomach has through long years of habit accustomed itself to digest certain forms of food better than others. This aspect has to be given due consideration, while evolving new types of food.

Sago gruel is an invalid food and is easily digested. Other forms of tapioca are also easily digested. South Indian coffee hotels and bakeries are using tapioca flour freely for various preparations. The trade is said to mix tapioca flour with other costlier flours successfully. Tapioca flour and products have to be used to a larger extent as a subsidiary food to tide over the present shortage of food grains. It is suggested that tapioca flour may be used for replacing rice flour, either partially or entirely, in preparations like *dosais*, *iddalies* and cakes of various types.

Cost of cultivation and returns: The cost of cultivation of tapioca is liable to vary widely but a rough estimate of the cost of cultivation in an acre of land is, however, given below, assuming that all items of labour, seed and manure are paid for.

Cost of cultivation of tapioca per acre

Particulars	Cattle pairs @ Rs. 2-4-0	Men at Re. 1 a day	Women @ 8 as a day	Cost Rs. A. P.
Ploughing 4 times.	8	8		26-0-0
Forming ridges and rectifying		6		6-0-0
Carting and applying manure	1½	2½	3	7-8-0
Cost of 10 cartloads of cattle manure at Rs. 4/- each load				40-0-0
Planting setts		1	6	4-0-0
Cost of 7,500 setts at Rs. 2/- per 1,000 setts				15-0-0
20 lift irrigations with mhote	50	50		162-8-0
Guiding water		20		20-0-0
Weeding twice			16	8-0-0
Earthing-up twice		10		10-0-0
Harvesting and carting tubers	2	8	12	18-0-0
Lease of land				60-0-0
 Total expenditure	 61½	 105½	 37	 377-8-0

Receipts

Value of 15,000 lb. of tubers at 20 lbs. per rupee	600-0-0
Value of stems (lump sum)	10-0-0
 Total receipts	 610-0-0
 Net profit per acre	 232-8-0

If an electrical motor and pump were used for lifting water, instead of mhone and bullocks, the cost of 360 units of electrical energy for 20 irrigations would be Rs. 22-8-0, instead of Rs. 162-8-0 with mhotes and there would be saving of Rs. 140/- and the net profit would be increased by Rs. 140/- and be Rs. 372-8-0 per acre.

Among the items of cultivation listed, the quantity of manure applied and the number of irrigations given are liable to vary widely and these variations influence the cost of cultivation and the yield obtained in a marked manner. The cultivator has the setts required for planting, the manure and the bullocks for lifting water from wells. In addition, the cultivator and members of his family work in the field and save labour to an extent. The amount actually spent on cultivation is therefore much less than what has been figured above. The efficient *ryot* reduces the expenditure on cultivation to the utmost without at the same time allowing the efficiency of production and the yields to be affected.

The profit obtained is the difference between the cost of cultivation and the price secured for the produce, which depends on the volume of the produce and the price at which it is sold. The yield and the selling price of produce are liable to fluctuate widely and such fluctuations tell on the final net profit obtained. Further, the produce obtained has been assumed to be 15,000 lb. of tubers per acre. This is a low yield for the high manuring and the heavy irrigations given and the yield obtained under such intensive cultivation would normally be much higher. Taking all these into consideration, it may be stated that the cultivation of tapioca is a profitable business that should appeal to the cultivator. Tapioca is an important commercial food-crop and cultivating tapioca at this time of shortage of food supply is a service to the country and profit to oneself.

The Blackheaded Caterpillar of Coconut (*Nephantis serinopa*)

Biological Control through utilisation of its Natural Enemies — Eulophids

(A Special Device for Rearing in Summer)

By

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and

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(Received on 30 — 7 — 1950)

The natural enemies of the blackheaded caterpillar of coconut: The black-headed caterpillar of coconut, *Nephantis serinopa* is attacked by a number of parasites in nature at different stages of its life-cycle.

Young larva : Apanteles
Growing larva : Microbracon
Full-grown larva : Bethylid
Pupating larva : Elasmid

Caterpillars are attacked by a predator Callida (Carabid beetle) but its effect in controlling the pest is insignificant.

Pupa: Chalcid Ichneumonid, Tachinid fly and Eulophid. It is possible by utilising these parasites to control this pest of coconut trees by introducing the parasites in areas where they are not found now and by breeding and multiplying some of the parasites in the laboratory and liberating them against the pest for strengthening the ranks of its enemies in nature. For the latter purpose, it is only those that are suitable for laboratory rearing that can be taken up. Amongst the natural enemies of *Nephantis serinopa* that can be bred and multiplied in the laboratory, Eulophid (*Trichospilus pupivora*) is important on account of (1) its suitability to laboratory rearing (2) its adaptability to alternate hosts like *Plibia*, *Sylepta*, *Prodenia*, etc., when *Nephantis serinopa* pupæ become scarce in the area and cannot be easily collected; the short duration of the life-cycle enables a large number of generations to be reared in the year; (4) its high fecundity; (5) its capacity to spread to considerable distances when released in nature on account of its active habits; (6) absence of any natural enemies of its own; (7) very high rate of as much as 50% parasitisation of the pest pupæ.

Difficulty in rearing the Eulophid parasite in summer in the Godavari Districts: In view of these advantages, this parasite was reared at Coimbatore and introduced in the districts of East and West Godavari for the biological control of the *Nephantis* pest and two regional substations

were opened at Razole and Narasapur for multiplying the parasites and releasing them in the two districts. It was observed that the parasite population got very much diminished during the hot summer months of April, May and June so that it was very difficult to rear the parasites in the laboratories at Razole and Narasapur during these months. On the other hand, these parasites were found to thrive in nature in the West Coast districts of Malabar and South Kanara, and this fact suggested the possibility of evolving a suitable method of rearing the parasites in the districts of East and West Godavari by adjusting the temperature and humidity in the rearing cages. At Coimbatore the parasite thrives best at a range of 78° to 82° F and 92-94 relative humidity (Cherian and Ananthanarayanan 1939)

**A DEVICE FOR REARING OF
EULOPHID PARASITES
IN HOT WEATHER**

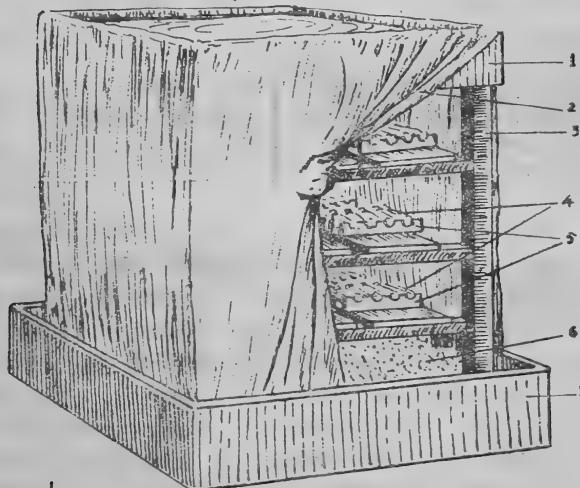


FIG. 1

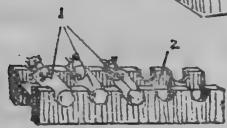


FIG. 2

FIG. 1
 1. WATER TRAY
 2. WET CLOTH
 3. RACK.
 4. REARING TUBES.
 5. STAND FOR TUBES.
 6. SAND
 7. SAND TRAY.

FIG. 2. | 1. REARING TUBES.
 2. STAND FOR TUBES.

Accordingly a moist chamber was devised for rearing the parasites in the Godavari tract during the summer months. It consists essentially of a small rack for holding the stands for the rearing tubes, three in a row crosswise (vide-Fig 1) These stands can be kept at different heights in the rack, 9 inches apart, so that there may be sufficient ventilation in the rack between successive layers. The number of rows that can be kept in

the rack can be varied according to convenience, by adjusting the height of the racks. At the top of the racks, a tray of water is kept and the whole stand is made to stand in a larger tray, filled with sand. Curtains made of *Khaddar* cloth are draped on the four sides and top of the rack, taking care to see that they are made to dip into the water kept in the tray at the top and also touch the sand in the bottom tray.

When only a limited quantity of water is to be absorbed by the curtains, the top ends are kept a little away from the water level in the tray and connected with the water by means of *Khaddar* strips, whose width is adjusted to the quantity of water to be absorbed by the curtains. The rack is kept opposite a window with a southern aspect, resting on a stool or table of the required height. The window is also provided with a *Khus-Khus* thatty. By means of this arrangement, it was found possible to maintain a temperature of 80-83°F inside the chamber irrespective of the temperature prevailing outside. Even on days when the temperature went up to 109°F, the moist chamber recorded only 82°F with a relative humidity of 90. The problem of ensuring favourable conditions of humidity and temperature, for the successful rearing of Eulophid parasites is thus solved to a great extent, in the Godavari districts during the summer months. The data given below serve to illustrate this fact.

Number of Eulophid parasites reared during : 1947 to 1950.

	1947 open rearing	1948 open rearing	1949 open rearing	1950 open rearing	With most Chamber.
April	Nil	Nil	Nil	Nil	22,000
May	Nil	Nil	Nil	Nil	60,000

To test whether the broods reared under artificial conditions are of sufficient vitality, consignments of Eulophids so reared were sent to Coimbatore from Narasapur in June 1950 and were found to give rise to parasites of quite normal activity.

Some Experiences with BHC and DDT

IV. The Paddy Grasshopper — *Hieroglyphus banian*, Fb.

By

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Government Entomologist

and

S. KANAKARAJ DAVID
Assistant Entomologist

The paddy grasshopper is one of the most destructive pests of this important food crop and its ravages are on record as early as 1888. Three species viz. *Hieroglyphus banian*, Fb., *Hieroglyphus oryzivorus*, Carl., and *Hieroglyphus nigrorepletus*, Bol., each having its own characteristic features and feeding habits have been observed in this country. Of these, *Hieroglyphus nigrorepletus* Bol. occurs both in short and full-winged forms and restricts its attention to dry crops cholam, maize, tenai and other lesser cereals and its zone of occurrence is limited to parts of the Ceded districts and Northern Circars. The other two species are specific pests of paddy. Of the two, *Hieroglyphus oryzivorus*, Carl., is mostly short-winged and occurs generally in the Northern Circars. *Hieroglyphus banian*, Fb., on the other hand, possesses full-sized wings, has a wider distribution and the present article deals with this species only. A comprehensive account of these grasshoppers are already appeared in the "Control of Rice Grasshopper" by Y. Ramachandra Rao and M. C. Cherian — (Indian Farming — Vol. I — No. 9 and 10 — 1940); but a short resume is given below to render this paper complete.

The pest — *Hieroglyphus banian*, Fb. The species has been reported from all the paddy-growing areas of this Presidency, but its incidence appears to be chronic to parts of Northern Circars and Malabar. These grasshoppers also take to sugarcane in an equally severe form, in parts of Visakhapatnam. The very fact that the pest is well-known by vernacular names such as 'Midatha' in Telugu, 'Pulpandu' in Malayalam, 'Jittika' in Oriya and 'Jitti' in Kanarese bears testimony to its notoriety in different parts of the State.

Life history and habits: The adults pair during October — November and insert their eggs in small masses under the soil, generally on the sides of the field bunds to a depth of 2 to 4 inches. The entire egg mass is encased within a water-proof sheath, which enables it to resist the adverse effects of moisture as well as heat. The eggs are quiescent throughout the cold weather and summer and the development

of the embryo takes place after the receipt of showers during the next May-June. The hoppers hatch out with the monsoon rains during June-July and feed on the grass growing on bunds, there being no paddy in the fields at this period. With the normal planting and growth of paddy, the young hoppers transfer their activities to the transplanted crop. The nymphal period is fairly long and extends from 6 to 12 weeks. The hoppers continue their damage and reach the adult stage by October — November, when the paddy crop is generally in shot-blade. The adults then pair, lay their eggs in the nearest bund and die off. From the records available, there appears to be only one brood during a season. In the case of sugarcane, the hoppers have been found to freely oviposit on the sides of ridges in the field.

Nature and extent of damage: As already mentioned, the nymphal stage of these hoppers extends from 6 to 12 weeks. The damage commences from the seed-bed and continues upto 2 to 3 months, reaching a maximum when the crop gets into shot-blade. In parts of Ganjam, where paddy is not grown under ideal conditions, the crop is often reduced to mere stumps due to these hoppers. In the Krishna district, however, paddy grows luxuriantly to a height of five feet by September-October and as such the plants very soon outgrow the slight damage caused in the earlier stages. Further, the hoppers do not appear to relish the thick, coarse outer foliage of a well-established crop and are, therefore, content with nibbling at the leaf-bases, as a result of which the long leaves break down and lodge. This sort of damage is characteristic of the pest and can be discerned even from a distance. The more serious loss is at the shot-blade stage, when the hoppers take to gnawing at the neck of flag-leaf and more often at the base of the young flower head inside. The earheads are unable to come out on account of the injury and if at all they emerge, they get distorted in shape. Even these are likely to break down subsequently, the injured stalks being unable to bear the weight of grains. The adult hop about at the slightest disturbance during the mornings and in the evenings. During the hotter hours, they rest in the dense foliage, sneaking under cover by sideways movements when they scent any danger. In severe cases, the pest is capable of causing a loss of 75% of the probable out turn.

Previous control methods: Various methods of control had previously been tried from time to time. Huge drag nets, smaller hand-nets, etc., were used and though a fairly good percentage of the population was caught and killed, invariably a good many of the hoppers were left behind in the field. Spraying with arsenical poisons, the use of poison baits, ploughing up of the fields, etc., were all equally ineffective.

Another method which is extant even to-day in parts of Malabar, is a systematic and organised drive of the hoppers towards a convenient corner of the field, where a bamboo mat screen is set up, to prevent the escape of the hoppers. Water is then splashed on the cornered hoppers, when they get temporarily dazed by the sudden contact with cold water, and are easily beaten to death. The local ryots are adepts in the art of driving and the process itself is quite interesting to watch. All these methods, however, took us nowhere nearer a real solution of the problem. By 1927-28 another way of tackling the pest in its egg stage was thought of. The sides of the field bunds being the favourite places of oviposition, a systematic campaign was organised to scrape the bunds upto a depth of 2 to 4 inches with the idea of exposing the egg masses to the action of weathering agencies and natural enemies. The method was given a fair trial on a large scale in Ganjam and Malabar, immediately after the harvest of the crop, when the bunds were still moist. A delay in the execution would result in the lands drying up and getting too hard, when the earth would break out only into big clods, without exposing the egg-masses. This method however created hardly any impression at all on the ryots, in spite of large-scale successful demonstrations by the department.

Work done: In September 1948 a serious outbreak of the pest occurred over extensive areas in Gudivada and Gannavaram taluks (Krishna District). None of the approved methods of control were practicable for controlling the pest. It was too late for bund-scraping nor was it possible to tackle the pest over such wide areas by the use of handnets. The only hope was in the trial of the two new chemicals, DDT and BHC, with which the Entomology Section had previously conducted laboratory tests. A severe incidence of the same paddy grass hopper was reported on sugarcane from Bobbili in September 1948. One of the members of the Section was deputed to this locality to try Gammexane (BHC) D. 025 and exploratory dusting trials were conducted in about half a dozen villages. The results were very encouraging. The lethal effect of the chemical was so clear-cut that the trials themselves served the purpose of demonstrations and also suggested the use of these chemicals against the hoppers on paddy in Krishna district. One hundredweight of BHC, D. 025 and smaller quantities of DDT were sent to the area and applied in some of the worst affected fields in a few villages as a preliminary trial. Here again the results of BHC D. 025 were far beyond expectations. A very high death rate of the adult hoppers and nymphs was observed within four hours after the treatment and there were no living insects at all in the dusted fields by the next day. The ryots being highly interested were closely following these experiments and got fully convinced about efficacy of the chemical. The good news spread like wild fire throughout the tract and there was a heavy demand for the insecticide and dusting appliances.

In all eight dusters and about 110 cwt. of BHC D. 025 were procured and the campaign was in full swing within a week of the preliminary trials. It was found difficult to meet all demands with the available quota of dusters; but the ryots themselves rose to the occasion and dusted their fields during night time also, so as to finish the work rapidly. They also applied the dust with their hands, just like broad casting seeds and very soon became adepts in the job. On the whole, the ryots were very grateful to the Department for this timely help and had no hesitation in meeting the entire cost of the insecticide themselves. The quantity of the chemical required for an acre was about 20 lb. and about 800 acres were treated during the course of three weeks. The loss caused by the hoppers was estimated at about 5 bags of grains per acre, worth about Rs. 60/-. The cost of the insecticide works out to Rs. 8/- thus leaving a clear margin of Rs. 52/- per acre. The campaign ended within three weeks of its commencement, since the pest itself was fast disappearing and the crop was getting into shot-blade, when it is not advisable to trample the fields. The North-East monsoon also broke out by this time, rendering all field work impossible.

Any type of hand rotary duster is quite efficient for the application of the dust, through a machine would cover a layer area of 2 to 3 acres in a day. A power duster (Root - 1 H. P.) was also tried. This machine was able to dust about 20 acres a day, but its use is not likely to become popular, as it was difficult to move it from field to field under the swampy conditions prevalent in the deltaic areas. Four to six men were required for carrying this machine into the field, besides two more for directing the discharge nozzles. The engine once it is started, goes on discharging the powder, there being no arrangement to close the outlet unless by switching off the engine itself. Added to these drawbacks, the adverse effect of trampling the fields by a gang of 6 or 8 men, the necessity for a competent mechanic to maintain the machine in working condition, the difficulty of getting petrol in remote villages, were also factors militating against its popularity.

Further Trials: Further tests were carried out in 1950 using BHC D. 025, Hexyclan 5% and DDT 3% in two centres, Malabar and Krishna District. The unit for each trial was one acre, replicated six times. Preliminary counts of the hopper population were taken for every replication in 6 randomised plots—each 10 sq. yards in extent—totalling in all 36 counts per treatment. Counts regarding the reduction in the population were taken on the same basis, 7, 24, 48 and 72 hours after the dustings. The figures are furnished in a separate statement.

The following are the conclusions that can be drawn from the data. The high lethal action of both BHC D.025 and Hexyclan 5% against the paddy grasshopper is established beyond doubt. A slightly

higher quantity of Hexyclan is required as this preparation is heavier. The mortality in either case was evident in about $1\frac{1}{2}$ hours and was more or less complete within 6 hours. The use of either BHC D .025 or Hexyclan 5% brings about the annihilation of the entire hopper population at a cost of 8 to 9 rupees per acre, whereas the mechanical methods previously in vogue are neither efficient nor cheap. DDT dust had but a feeble action against this pest even upto 72 hours. The small-scale trials have also indicated the efficacy of lower concentrations of BHC at 2, 3 and 4%. BHC and Hexyclan are at present manufactured only in standard grades of 5% and above. It is also understood that no appreciable reduction of the prices would be possible by lowering the concentration since the cost of the diluent as well as the labour charges would remain more or less the same. Other trials with suspensions and emulsions of DDT and BHC as well as E 605 (Parathion) Toxaphene etc., also indicate the possibilities of effective control.

With the knowledge gained in this campaign, the insecticide was tried against the other insect pests also and the results have been equally successful. To mention a few examples, over 2,000 acres of dry crops infested by *Hieroglyphus nigrorepletus*, Bol., in Cuddapah and another 200 acres of paddy attacked by *Oxya velox*, F., at Guntur were saved by the use of about 27 tons of BHC D .025. The lesser grasshoppers viz., *Chrotogonus saussurei* B., and *Aeolopus* sp., were also effectively controlled in isolated localities.

During the conduct of these large-scale control measures, a few other interesting factors also came to light. *Aeolopus* sp. appears to succumb almost within an hour after contact with the chemicals, while the earliest mortality is noted in $1\frac{1}{2}$ hours in the case of *Hieroglyphus banian* Fb. The ground grasshopper, *Chrotogonus* sp., appears to die more slowly. An interesting finding in the course of the work is that the nymphs of the Deccan grasshopper, *Colemania sphenaroides* B., require a higher concentration of 7 to 10% of BHC or Hexyclan for a complete kill, the 5% dosage not being effective.

Conclusions: BHC D. 025 was used with remarkable success on a large scale for the first time in the Department, against the paddy grasshopper.

2. About twenty pounds of the dust are required to dust an acre and the cost is about Rs. 8/-.

3. Hexyclan 5%, a similar compound, is equally effective.

4. Lower concentrations of BHC also produce the desired results, but are is not likely to bring about any appreciable reduction in the cost.

5. The chemicals may be applied during September—October before the crop comes into shot-blade. The dusting, if done later, will be useless since the pest dies off by the end of October after causing enough havoc and ensuring the next generation also by laying eggs. The probable outbreak of the North-East monsoon would be another impediment for the satisfactory application of the dust.

6. Any pattern of a rotary duster is quite efficient, failing which the dust can as well be broadcasted by hand with a little practice.

7. Other chemicals, like Toxaphene, E 605 (Parathion) DDT emulsion and BHC spray have indicated their efficacy, but their practical application depends upon their easy availability and the comparative cost of the treatment.

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STATEMENT

Place.	Treatment.	Before treatment.		After treatment.		Percentage reduction in population	Earliest time taken for death.	Quantity consumed per acre.	Cost per acre.	Remarks.			
		6 hours.	24 hours.	48 hours.	72 hours.								
		1	2	3	4	5	6	7	8	9	10	11	12
Live. Dead. Live. Dead. Live. Dead. Live. Dead.													
Malahar I Field Trials.													
Alathur	BHC D. 025	93	3	44	...	8	...	4	...	...	100	1 $\frac{1}{2}$	23
Village	Hexyclan 5%	84	1	86	1	13	...	5	...	1	100	1 $\frac{1}{2}$	28
	DDT 3%	90	93	...	48	1	35	2	44	...	45	24	29
	Control	76	...	...	81	...	93	...	107	...	...	...	...
Circles.													
Gudivada.	BHC D. 025	64	24	...	8	...	...	...	...	...	100	1	20
	Hexyclan 5%	72	8	...	...	...	56	...	44	...	100	1	20
	DDT 3%	80	88	...	48	...	56	...	44	...	45	24	20
	Control.	72	88	...	86	...	112	...	90	...	...	...	...

The counts were taken in randomised plots eat 10 sq. yards in extent @ 9 plots per acre and the figures represent the average of the

6 replications

II Small Scale trials.

Alathur.	BHC 3%	12	...	...	1	...	...	...	...	...	92	3	...
	Toxaphene 10%	8	...	...	...	...	...	...	...	...	100	3	...
(Sprays)	BHC 0.6%	7	...	...	...	...	...	...	...	...	100	1 $\frac{1}{2}$	...
,	Hexyclan 0.05%	6	...	...	...	...	...	...	...	...	100	1 $\frac{1}{2}$	...

Correspondence.

To

THE EDITOR, MADRAS AGRICULTURAL JOURNAL.

Dry ploughing — its use and harm

Sir,

It is said dry ploughing is good if done 120 days before sowing. Again there are other ways of ploughing :

1. ploughing when the soil has subsoil moisture $1\frac{1}{2}$ to 2 feet deep,
2. ploughing under semi-dry or semi-wet conditions,
3. Dry ploughing.

These have different effects on the succeeding crops, with and without irrigation.

Again in sowing there are different ways.

The depth under which the seed is put, has a great effect on the crop. There are problems for the modern semi-educated landed and other ryots.

*

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By the way I noticed in the last Madras Agricultural Journal, a treatise on (1.) Banana and (2.) Sweet-potato, occupying some 40 pages of the Journal. If there are not very good subjects for the Journal a discussion in some two or three pages, on the above subjects may find a place in the Journal. These subjects may be too familiar to you, but for the "New-comers" to the profession of agriculture, this may be of great value.

Again, in the old "Annual Reports of the Agricultural College" there are here and there interesting subjects for the layman ryot and these too may be occasionally given some place in the Journal.

Avarampalayam,
Ganapathi P.O. }
Coimbatore

A. P. KRISHNASWAMY NAIDU.

Agriculture Newsletter, Madras

A special variety of paddy for the Tanjore Delta Areas. The Tanjore delta area, due to its low-lying nature is unfit for cultivation during thaladi (second crop) season as it is subject to heavy flooding during the North-East monsoon. Hence most of it is left fallow during thaladi. But a compact area of about 6,000 acres in Shiyali taluk (Tanjore district) and Chidambaram taluk (South Arcot district) is under "Kullakar", a red-riced, coarse-grained variety of paddy, during the period from February to May. This variety of paddy has a good productive capacity during this season. The average yield of grain is 3,000 lb. per acre and the duration is 120 days. Pure line selection work on this variety was started at the Agricultural Research Station, Aduthurai, in 1943—1944. After three years of comparative yield tests, one culture No. 13272 was found to be the best for the tract giving an average increase of 12 per cent over the unselected seed of the variety. This has, therefore, been released as strain ADT 23. It would be worthwhile to try the performance of this strain in Chingleput, South Arcot, North Arcot and other districts where paddy cultivation is in vogue in the corresponding seasons.

Irrigated Cholam for Madhurai tract. In Mathurai district irrigated cholam is grown over 80,000 acres. Most of this area is concentrated in the taluks of Periakulam, Nilakkottai and Dindigul. The varieties grown are locally known as *Salangai Vellai* and *Azhukkvelai* cholam. In 1942 large collections of important varieties of the locality were made for breeding work at the Millet Breeding Station, Coimbatore. As a result of the work done three high-yielding varieties of *vellai cholam* have been evolved for the tract. They have been tried in cultivators' fields in Dindigul and Periakulam taluks and the trials have been satisfactory.

Bright future for chilli cultivators. Madras leads other States in the cultivation of chillies. The largest producing areas lie in the Circars, 70,000 acres being cultivated with chillies in Guntur alone. Over two decades ago, Madras was exporting chillies to other places but subsequently the crop suffered a reduction in acreage and yield on account of the ravages of an insect pest (*Seirtothrips dorsates*). The advent of this thrip happened to synchronise with the introduction of groundnut which has spread over a vast area owing to its value as a cash crop. About a decade ago an improved strain (G.1) was evolved at the Agricultural Research Station, Lam. A scheme for the improvement of chillies has recently been taken up at this Research Station. It involves the study of a wide collection of chillies from different parts of India and abroad and includes a programme of hybridisation. It is hoped that before long a variety of chillies which will be a further improvement over G1 for increased tolerance to thrips, higher pungency, greater retentivity of colour under storage, longer pods, better yield, or all these qualities combined, will be available for distribution in the Circars. With the release of such strains coupled with the advantages accruing from the use of insecticides and sprays under the guidance of the Plant Protection Staff, the prospects of a bigger and healthier crop of chillies are quite bright.

Water hyacinth—A new use. Water hyacinth is an aquatic plant which has been looked upon as an unwanted and obnoxious material condemned as much by agriculturists as by irrigation authorities. Its prolific growth and spreading habit makes it all the more unpopular, for in watercourses it obstructs the flow of water and blocks the sluices thus impairing the efficiency of irrigation. Recently, however, a new use has been found for this plant. In Tirunelveli municipal area there are two ponds, one of them covering roughly an acre and the other about 10 acres, which are overgrown with this plant. Head loads of the plant weighing 50 lb. are taken out daily for feeding buffaloes in the neighbouring area. It has

been found that feeding the buffaloes with 15 lb. of water hyacinth per day increases their milk by 10 to 15 per cent, but the milk is rather watery and the butter extracted does not possess the proper consistency and flavour. Possibly a suitable combination of this feed with concentrates to be worked out by feeding trials, might remove this defect. The nutritive value of the material is higher than that in grass. It is phosphoric acid alone that needs to be supplemented. The average yield per acre of water surface has been estimated at 60 tons per annum. Since the removal of this plant will be a great boon to the authorities, cuttings can be taken free of charge; and hence the buffaloes feed is within the reach of every buffalo owner.

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BILL :- But, I thought you never committed the same mistake twice.

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Crop and Trade Reports

Statistics—Agriculture—Cotton Crop—1950-51 Madras State—Second Forecast Report. The area under cotton in the Madras State up to 25th September, 1950 is estimated at 468,300 acres. Compared with the area of 461, 500 acres estimated for the corresponding period of last year this is an increase of 1·5 per cent. The increase is due partly to intensive propaganda for extension of cotton cultivation and partly to better prices.

2. *Central districts and the South - Mainly Cambodia Tract:* The area in this tract decreased from 82,300 acres to 73,600 acres i. e. by 10·6 per cent due mainly to inadequate rains in Coimbatore, Tiruchirapalli, Madhurai and Tirunelveli districts. In Salem district however, there was an increase as a result the cotton extension scheme although the rains were delayed.

Westerns Tract: The area under Westerns increased from 304, 800 acres to 310, 500 acres i. e. by 1·9 per cent. The increase is due mainly to an increase in the area in Bellary district.

White and Red Northerns: The area under White and Red Northerns increased from 32,400 acres to 42,500 acres (i. e.) by 31·2 per cent due to favourable seasonal conditions in Kurnool district in the earlier months.

Warangal and Cocanadas: The area under Warangal and Cocanadas fell from 39,300 acres to 39,000 acres i. e., by 0·8 per cent.

3. The condition of the crop is reported to be generally satisfactory except in the districts of Guntur where the crop is reported to be a little stunted due to the initial delay in sowings.

4. The average wholesale price of cotton unit per imperial maund of 82 2/7 lb. (equivalent to 3,200 tolas) as reported from important markets on 7th October, 1950 was Rs. 74-7-0 for cocanadas, Rs. 84-8-0 for white Northerns, Rs. 82-5-0 for Red Northerns Rs. 81-12-0 for Westerns (Mungari), Rs. 85-11-0 for Westerns (Hingari) Rs. 106-0-0 for Coimbatore Cambodia, Rs. 94-7-0 for Coimbatore Karunganni and Rs. 85-9-0 for Tinnevellies and Rs. 63-0-0 for Nadam cotton. Compared with the prices published in the last report, i. e. those which prevailed on 5th September 1950, these prices reveal a rise of approximately 0·6 per cent in the case of Tinnevellies, 0·4 per cent in the case of Coimbatore Karunganni and 0·2 per cent in the case of Coimbatore Cambodia, a fall of 2·5 per cent in the case of Cocanadas, 1·6 per cent in the case of Westerns (Mungari) and 1·5 per cent in the case of Westerns (Hingari) the prices remaining stationary in the case of white and red Northerns and Nadam cotton.

5. Figures by districts are given in the statement appended.

COTTON-II—FORECAST

(Area in hundreds of (i. e.) 00 being omitted)

District or Tract	Estimates of the area sown upto the end of			Increase (+) decrease (—) of the area in column (3) as compared with area in column (4)
	July 1950	Sept. 1950	Sept. 1949	
1	2	3	4	5
		Acres.	Acres.	Acres.
Chingleput	...	1	1	...
South Arcot	...	20	65	50
Chittoor	...	Nil	Nil	Nil
North Arcot	...	1	1	2
Salem	...	66	120	100
Coimbatore	...	50	100	130
Tiruchirapalli including Pudukottai	...	28	45	57
Tanjore	...	Nil	Nil	Nil
Madhurai	...	90	110	116
Ramanathapuram	...	95	160	160
Tirunelveli	...	90	120	160
Malabar	...	Nil	12	5
South Kanara	...	1	2	2
Total (mainly cambodia including Nadam and Bourbon)	...	442	736	823
Kurnool (Pattikonda taluk only)	...	18	155	106
Bellary including Sandur	Mungari	20	568	548
	Western	69	1932	1862
Anantapur	Mungari	4	119	144
	Western	7	221	266
Cuddapah	...	3	110	120
Total Westerns	...	121	3,105	3,046
Kurnool (Excluding Pattikonda but including Banganapalli)	...	27	425	324
Total White and Red Northerns	...	27	425	324
Visakhapatnam (Golconda taluk only)	...	10	11	12
East Godavari	...	3	18	21
West Godavari	1
Krishna	...	1	1	1
Guntur	...	30	220	200
Nellore	...	Nil	140	158
Total (Warangal and Cocanadas)	...	44	390	393
Visakhapatnam (except Golconda taluk) Chinna- patti or short staple.	...	26	19	29
Srikakulam	8	...
Grand Total	...	660	4,683	4,615
				+ 68

Statistics—Crop—Potato—III and Final Forecast report—1949—1950—
Madras State. The potato crop is grown chiefly in the Nilgiris District and to a small extent in the Salem and Madhurai districts of the Madras State. The present report is the final report for the year 1949—1950. The area sown under winter and summer crops of potato in the Madras State during the year 1949—1950 is estimated at 19,000 acres. Compared with the extent of 17,100 acres in the previous year, this is an increase of 11·1 per cent

In all the three districts, viz., the Nilgiris, Salem and Madhurai, the area estimated shows an increase. In the Nilgiris district the increase has been attributed to the prevalence of high price for potatoes. The yield of the crop (both summer and winter) is estimated to be below normal. In the Nilgiris district, it has been attributed to adverse seasonal conditions. Estimates of area and yield by districts are given below:—

District	Estimated area in 1949—1950 (acres)	Seasonal Factor	Estimate production in (1949—1950) (Tons)
(1)	(2)	(3)	(4)
Salem	...	260	78
Madhurai	...	440	75
The Nilgiris	...	18,300	80
State	...	19,000	52,900

Cotton Raw, in the Madras Presidency. The receipts of loose cotton at presses and spinning mills in the Madras Presidency from 1st February 1950 to 5—1—1951 amounted to 3,04,729 bales of 392 lb. lint. The receipts in the corresponding period of previous year were 4,08,860 bales. 3,35,043 bales mainly of pressed cotton were received at spinning mills and 18,347 bales were exported by sea while 1,49,253 bales were imported by sea mainly from Karachi and Bombay. (Director of Agriculture, Madras.)

Weather Review — For December 1950

RAINFALL DATA

Division	Station	Total for the month in inches	Departure from normal in inches	Total since January 1st in inches	Division	Station	Total for the month in inches	Departure from normal in inches	Total since January 1st in inches
Orissa & Circars.	Gopalpur	0.0	-0.5	47.6	Central- Contd.	Coimbatore (C. B. S.)*	0.0	-1.6	20.5
	Calingapatnam	0.0	-0.5	30.1		Coimbatore	0.1	-1.3	16.6
	Vishakhapatnam	0.7	+0.1	38.3		Tiruchirapalli	1.1	-1.5	26.5
	Anakapalle*	0.0	-0.8	33.9		Nagapattinam	3.9	-7.1	48.2
	Samalkot*	0.0	-0.3	41.2		Aduturai*	2.3	-2.2	35.0
	Kakinada	0.0	-0.7	41.9		Pattukkottai*	5.5	+0.8	36.1
	Maruteru*	0.0	-0.6	52.1		Madhurai	0.4	-1.6	32.1
	Masulipatnam	0.0	-0.7	36.3		Pamban	3.0	-5.0	25.0
	Guntur*	0.0	-0.5	31.5		Koilpatti*	0.0	-2.3	18.7
	Agri. College, Bapatla*	0.0	-0.8	30.5		Palayamcottai	4.1	-0.1	26.9
	Rentachintala	0.0	-0.1	22.8		Ambasamudram*	14.3	+6.7	41.2
Ceded Dists.	West Coast.				Mysore & Coorg.	Trivandrum	0.9	-1.6	64.8
	Kurnool	0.0	-0.2	29.0		Fort Cochin	0.1	-1.5	134.9
	Nandyal*	0.0	-0.4	25.7		Pattambi*	0.0	-1.8	158.1
	Hagari*	0.0	-0.3	24.1		Calicut	0.0	-1.5	128.9
	Siruguppa*	0.0	-0.1(a)	28.7		Taliparamba*	0.0	-1.7	148.7
	Bellary	0.0	-0.1	23.5		Nileshwar*	0.0	-1.9	172.4
	Cuddapah	0.0	-0.8	20.3		Pilicode*	0.0	-2.2@	144.8
Carnatic.	Kodur*	0.0	-4.9	22.6		Mangalore	0.0	-0.7	148.9
	Nellore	0.0	-2.9	52.9		Kankanady*	0.0	-0.6	150.4
	Buchireddi-palem*	0.0	-3.5	39.1	Hills.	Chitaldrug	0.0	-0.5	24.8
	Madras (Meenambakkam)	0.6	-4.9	36.5		Bangalore	0.0	-0.4	31.5
	Tirukkuppam*	0.1	-6.0@	36.0		Mysore	0.0	-0.4	28.6
	Palur*	5.8	-1.0	40.0		Mercara	0.0	-0.7	134.5
	Tindivanam*	1.5	-2.9	27.2		Kodaikanal	3.6	-1.6	47.2
Central.	Cuddalore	5.5	-2.0	34.7		Coonoor*	1.4	-5.0	44.7
	Vellore	0.1	-2.5	19.3		Ootacamund*	1.7	-1.0	44.3
	Gudiyatham*	0.1	-2.3	15.4		Nanjanad*	0.7	-0.9	55.5
	Salem	0.3	-0.7	30.1					
	Coimbatore (A. C. R. I.)*	0.1	-1.6	22.0					

Note:— (1) * Meteorological Stations of the Madras Agricultural Department.
 (2) Average of ten years data is taken as the normal.
 (3) @ Average of seven years data for Tirukkuppam and eight years data for Pilicode is given as normal.
 (4) Taluk office normal is 0.14" and rainfall is Nil.
 (5) £ Rainfall 1 to 4 cents.

"Weather Review for December 1950."

The seasonal trough of low pressure in the South Bay of Bengal became well marked on 1—12—1950, and concentrated into a depression on the next day, moving towards North-North East. Under its influence there were a few light showers in South and coastal Tamilnad. The depression in the Bay resulted in a cyclonic storm on 4—12—1950, and after being active for another day weakened and became unimportant on 7—12—1950. The seasonal trough of low pressure re-established itself over the South Bay on 7—12—1950 and became well-marked on 11—12—1950. The discontinuity associated with it lay in the South-West Bay east of Ceylon, on 12—12—1950, and became more active and finally shifted to the West on the next day. Under its influence the North East monsoon strengthened in the southern half of the Peninsula causing widespread rains and a few heavy falls in Tamilnad and Travancore-Cochin. A rainfall of 4.41" was received at the Research Station at Ambasamudram. The discontinuity shifted further westwards and became unimportant on 16—12—1950. Weather was mainly dry over the region from 16 to 21—12—1950 and due to the incursion of maritime air in the Peninsula, south of latitude 11° North, showers were recorded at a few places in South Tamilnad and Travancore-Cochin on 22—12—1950, and 23—12—1950. Due to the development of a well-marked trough of low pressure over South Gujarat and North Deccan on 24—12—1950, the North-East monsoon showed symptoms of strengthening in the South West Bay of Bengal.

During the month five western disturbances passed over North-West and North India.

Night temperatures were below normal over most of the region up to 12—12—1950 and after some slight fluctuations were above normal over most of the region. Coastal Andhra-Desa experienced sub-normal minimum temperatures up to 25—12—1950.

Rainfall was below normal over the region except in Vizagapatnam, Pattukkottai and Ambasamudram. Particulars about the noteworthy falls and zonal rainfall during the month are furnished below :—

S. No.	Date	Place	Rainfall in inches for past 24 hours
1	13—12—1950	Ambasamudram	7.41"
2	13—12—1950	Pattukkottai	3.34"
3	13—12—1950	Nagapattinam	3.00"
4	13—12—1950	Kodaikanal	2.90"
5	14—12—1950	Cuddalore	3.10"

Zonal Rainfall.

S. No.	Name of the Zone.	Total precipitation.
1	Orissa and Circars	Below normal
2	Ceded Districts	Below normal
3	Carnatic	Far below normal.
4	Central	Below normal
5	South	Below normal
6	West Coast	Below normal
7	Mysore and Coorg	Below normal
8	Hills	Below normal

Departmental Notifications

GAZETTED SERVICE—POSTING AND TRANSFERS

Name of officers	From	To
Sri Karunakar, P. D.		To hold full additional charge of the post of Principal from 1-12-60.
,, Alagiamanavalan, R.	Addl. D. A. O., Tanjore.	Sugarcane Inspector, Nellikuppam.
,, Balasubramaniam, T. N.	Addl. D. A. O., Tirunelveli,	Sugarcane Inspector, Samalkot.
,, Bhavani Shanker Rao, M.	Superintendent, A. R. S. Nileshwar.	Superintendent, A. R. S. Tindivanam.
,, Mukundan, M.	D. A. O., (on leave),	Sugarcane Inspector, Visakhapatnam.
,, Muthuswami Iyer, S.	Addl. D. A. O., Madhurai,	Sugarcane Inspector, Madhurai.
,, Raghavan, A.	Asst., Cotton Specialist, Hagari,	Asst., Cotton Specialist, Siruguppa.
,, Rajasekhara Mudaliar, C.	Asst., Lecturing and Systematic Botanist, Coimbatore,	Lecturing and Systematic Botanist, A. C. and R. I., Coimbatore.
,, Satyanarayana-murthi, K.	Asst., Cotton Specialist, Siruguppa,	Asst., Cotton Specialist, Hagari.
,, Subramania Iyer, K. H.	Addl., D. A. O., Trichinopoly,	Sugarcane Inspector, Vuyyuru.

Subordinate Service

Name of officers	From	To
Sri Appalanarasayya, P.	F. M., Araku Valley,	Asst., in Mycology,
,, Appavu Naidu, C.	A. A. D., Madanapalli,	S. R. S., Anakapalli.
Srimathi Andal, R.	Mycology Asst., Coimbatore,	P. P. A., (Mycology), Ootacamund.
Sri Annaswami, N.	Special A. D., Tirunelveli,	A. D., Nanguneri.
,, Adinarayananamurthy,	Cotton Asst., N. P.	F. M., Central Farm, Coimbatore.
,, Balasubramaniam,	Special A. D., Manure Mennargudi,	Addl., A. D., Attur.
,, Bhima Sastry, A.	Asst., in Paddy, Maruteru,	Millet Asst., Narasapatanam.
,, Banki Rao, B.	Millet Asst., Nandyal,	Seed Development Asst., Cuddappah.
,, Bhaskara Rao, C.	Seed Development Asst., in Paddy, Cuddappah,	Asst., in Paddy, Maruteru.
,, Chandrasekharan, P.	Asst., in Millets, Coimbatore,	Cytogenetics Asst., Coimbatore.
,, Chandrasekharan, P.	F. M., Central Farm, Coimbatore,	Special A. D., Sugarcane Chittoor.

Name of officers	From	To
Sri Chandra Rao, P. V.	Asst., in Entomology, Anakapalle,	A. D., Kalahasti.
,, Devasikhamani, T.	A. D., Kurnool,	P. A., to D. A. O., Kurnool.
,, Ebenezer, J.	Addl., A. D., Chingleput,	A. D. D., Thiruthuraipundi,
,, Gopalarathnam, S.	A. D., Pulivendla,	Special A. D., Sugarcane Bebbili.
,, Gopalakrishnan, S.	Asst., in Plant Physiology, Coimbatore,	Asst., in Chemistry, Coimbatore
,, Hanumantha Rao, Ch.	A. A. D., Repalle,	Asst., in Paddy R. B. S., Buchireddipalem.
,, Jayaraman, R.	Asst., in Oil Seeds, A. R. S., Tindivanam.	Asst., in Paddy, A. R. S., Aduthurai.
,, Krishnamurthi, K. A.	Asst., in Cotton, Coimbatore,	Special A. D., Cotton Scheme, Palladam.
,, Kameswara Sarma, V.	Special A. D., Manures Masulipatam,	A. D., Anakapalli.
,, Kulasekharan, C. R.	Special A. D., Manures Nannilam,	A. D., Sriperumpadur.
,, Kulandaiswami, M.	Special A. D., Sugarcane, Karur,	A. D., Musiri.
,, Kalimuthu, M.	P. A., to D. A. O., Vellore,	A. D., Tirumangalam.
,, Krishnamurthi, R.	F. M., C. F., Coimbatore,	Asst., in Entomology, Coimbatore.
,, Koteswara Rao, T.	A. D., Pattikonda,	A. D., Narasaraopet.
,, Kunhunni Nambiar, V. K.	F. M., (on leave),	F. M., A. R. S., Taliparamba.
,, Krishnamurthi, S.	A. D., Ariyalur,	A. D., Vellore.
,, Krishnamurthi, N. H. V.,	Asst., in Paddy (on leave),	Asst., in Paddy A. R. S., Maruteru.
,, Lakshminarayana Rao, L.	On leave;	Cotton Asst., Western Scheme, Adoni.
Srimathi Leela David,	Asst., in Entomology, Coimbatore,	Teaching Asst., in Entomology, Bapatla.
Sri Loganathan, M. S.,	A. A. D., Thiruthuraipundi,	A. A. D., Chingleput.
,, Mukundan, T. K.	P. P. A., (Mycology), Kozhikode,	P. P. A., (Entomology), Kozhikode.
,, Muhammad Azamatullah Khan,	Paddy Asst., Buchireddipalem,	A. A. D., Madanapalli.
,, Marappan, P. V.	Special A. D., Cotton Scheme, Palladam,	Asst., in Cotton, Coimbatore.
Kumari K. Muktha,	Mycology Asst., Coimbatore,	Asst., in Paddy, Coimbatore.
Sri Madhava Rao, T.	Special A. D., Manures Gudiyada,	A. D., Kurnool.
,, Meenakshisundaram, M. N.	Special A. D., Manures, Madhurai,	P. A., to D. A. O., Vellore.
,, Narayana, K. L.	Teaching Asst., in Botany Bapatla,	Asst., in Entomology, A. R. S., Siruguppa.

Name of officers	From	To
Sri Narayananurthi, R.	Special A. D., (on leave),	Fruit Inspector, Kodur.
.. Narasimha Rao, R.	Special A. D., Manures	Cotton Asst.,
	Avanigudda,	Narasaraopet.
.. Narasimha Raju, K. A.	A. D., Chodavaram,	F. M., Araku Valley.
.. Nagarajan, V.	A. D., Tiruturaipundi,	F. M., A. R. S., Aduthurai.
Kumari, G. Pushpaveni,	F. M., S. R. S., Anakapalle,	Asst., in Entomology Sugarcane Station, Anakapalle.
Sri Prabhakara Rao, G.	A. D., Kudligi,	Sugarcane Development Scheme, Hospet.
.. Palaniswami, V. G.	A. A. D., Musiri,	F. M., A. R. S., Palur.
.. Periyaswami, S.	Entomology Asst.,	Entomology Asst., Shembaganur.
.. Parthasarathy Reddi, V.	F. M., C. F., Coimbatore,	Special A. D., Sugarcane, Chittoor.
.. Ramakrishnan, V.	Fruit Inspector, Kodur,	Asst., in Botany, Coimbatore.
.. Rama Rao, G.	Special A. D., Sugarcane, Bobbili,	F. M., S. R. S., Anakapalle.
.. Raghava Rao, N.	Millet Asst., Narasapatanam,	A. A. D., Kurnool.
.. Ravendra Rao, G.	A. A. D., Guntur,	A. D., Repalle.
.. Raghavendra Rao, J.	A. D., Ooty,	A. D., Pulivendla.
.. Ramaswami, K. R.	Asst., in Paddy,	Asst., in Meteorology, Coimbatore.
.. Rangaswami, P.	Botany Asst., Coimbatore,	F. M., C. F., Coimbatore.
.. Ramachandran, K.	Seed Development Asst., Palghat,	Asst., in Cotton, Coimbatore.
.. Ramakrishnan	F. M., Taliparamba,	Oil Seeds Asst., Piliode.
.. Nambiar, C.		A. D., Srivilliputtur.
.. Rangaswami Reddiar, S.	Special A. D., Manures Ambasamudram,	A. D., Vegetable Scheme, Madras.
.. Raghavan, K.	A. D., Sriperumpadur;	A. D., Palladam.
.. Sambandam, C. N.	A. D., Nanguneri,	Cotton, Asst.,
.. Sargunam Davis Peter,	A. D., Tirumangalam,	Coimbatore.
.. Subramaniam, R.	Special A. D., Manures Sholavandan,	A. D., Gudiyattam.
.. Sanjeevi, P. S.	Special A. D., Manures,	Special A. D., Sugarcane, Karur.
.. Subramaniam, S.	Karur, Asst., in Chemistry,	F. M., C. F., Coimbatore.
.. Srinivasamurthi, M.	Coimbatore,	A. D., Tiruturaipundi.
.. Sivasankaran, S.	Cotton Asst., Coimbatore,	A. A. D., Musiri.
.. Subba Rao, K.	Paddy Asst., Aduthurai,	A. D., Gokavaram.
.. Srinivasulu, K..	Special A. D., Sugarcane Chittoor,	Asst., in Paddy R. R. S., Tirukkuppam.

Name of officers	From	To
Sri Shanmugam, S.	Special A. D., Sugarcane, Hospet,	A. D., Kudligi.
,, Sreeramulu, C.	A. A. D., Kurnool,	Millet Asst., Nandyal.
,, Subbayya, J.	A. D., Entomology, Kandukur,	Asst., in Entomology, Coimbatore.
,, Satyanarayana, P.	A. D., Repalle,	A. A. D., Guntur.
,, Shiva Rao, K.	A. A. D., Bhimavaram,	A. A. D., Repalle.
,, Satyanarayana Rao, K.	A. D., Gonavaram,	A. D., Kandukur.
,, Satyanarayana, K.	A. D., Parvatipur,	A. D., Salur.
,, Sundaresan, K. R.	F. M., Sugarcane Liaiaon Farm, Nellikuppam,	Special A. D., Manures, Chidambaram,
,, Seshachala Sarma,	Asst., in Paddy A. R. S., Maruturu,	A. A. D., Adoni.
Srimathi Sabharanji Amma,	Teaching Asst., in Entomology, Bapatla,	Teaching Asst., in Botany, Bapatla.
Sri Srinivasa Rao, U. L.	On leave,	F.M., A R. S., Nanjanad.
,, Suryanarayana Iyer, P.S.,	P.P.A. (Entomology) Kozhikode.	P.P.A. (Mycology) Kozhikode.
,, Sithapathi Rao, S.,	A. D., Amalapuram,	A. D., Sompeta.
,, Subramaniam, P. T.,	F.M., A.R.S., Taliparamba,	A.A.D., Ponnani.
,, Satyanarayana, T.,	A.D., Narasaraopet,	A. D. Bapatla.
,, Venkatakrishnan, T.,	P. A., to A. O.,	F. M., C.F., Coimbatore.
,, Venkata Reddy, G.,	Cotton Asst., Narasaraopet,	Asst., in Cotton Mungari Cotton Scheme, Adoni.
,, Vasudeva Rao, S.,	A.D., Salur	A. D., Ellamanchilli.
,, Vaidyanathan, J.,	Special A. D., Manures, Tanjore.	F. M. A. R. S., Palur.
,, Venkateswaran, A.N.,	Asst., in Oil seeds, Pilicode,	Coconut Nursery Asst., Coimbatore.
,, Vijayam P.K.,	Entomology Asst., Kalpetta,	F.M.. A.R.S., Taliparamba.
,, Venkataramana, G.,	F. M., Pattukottai,	Seed Development Asst., Coimbatore.
,, Venkateswara Rao, A.,	Coconut Nursery Asst.,	A.A. D., Bhimavaram.

Appointments.

The following candidates are appointed as upper subordinates and posted to the vacancies shown against each :—

Sri Gopala Raju, D.,	Asst., in Mycology, Coimbatore.
,, Lakshmanan, S.,	Asst., in Plant Physiology, Coimbatore.
,, Venkata Reddy, T. C.,	Asst., in Mycology, Coimbatore.

The following six B. Sc. (Agri) Graduates are selected for training in Agricultural Engineering for one year at the Engineering Workshops at Coimbatore and Madras :—

Sri Alagiriswami, R., A.D.,	A.D., Srivilliputtur.
,, Chockalingam, M., A.D.,	A.D., F.M.. C.F., Coimbatore.
,, Kodandaraman, S. E.,	A.D., Vegetable Scheme, Madras.
,, Nageswara Rao, T.,	A.D., Bapatla.
,, Narasimhalu., T.R.,	A.D., Palladam.
,, Somalingam, R.,	A.D., Musiri.

Agricultural College and Research Institute, Coimbatore

LIST OF ADDITIONS TO LIBRARY FOR DECEMBER, 1950.

1.	...	(1950)	American Museum of Natural Society : Survey of Contemporary knowledge of biogeochemistry 3. Biogeochemistry of Vertebrate Excretion.
2.	BRANDT (Karl) :	(1945)	Reconstruction of World Agriculture, W. W. Norton Co.,
3.	...	(1950)	England Commonwealth Economic Committee Plantation Crops.
4.	FREAR :	(1950)	Agricultural Chemistry V. I 1st Edn., Van Nostrand Co.,
5.	...	(1950)	Industrial and Commercial India—2nd Edn., 1950. A. A. Publishers, Calcutta.

**The Madras Agricultural Students' Union,
LAWLEY ROAD P. O.**

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Appeal

- All members and subscribers of the
- Madras Agricultural Journal are earnestly
- requested to clear off all their arrears,
- if any. This would be a great help to the
- finances of the Union.

